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Field Keys to Predators of the Balsam Woolly Aphid in North Carolina

Abstract. — These keys will be useful for field identification of immature insect, adult mite, and slug predators of the balsam woolly aphid. The keys include, in addition to native predators, the larvae of three species introduced to North Carolina.

These keys were devised for field identification of immature insect, adult mite, and slug predators of the balsam woolly aphid, *Adelges piceae* (Ratzeburg) (Homoptera: Phylloxeridae). They should be useful to researchers evaluating the effects of predators on *A. piceae* populations.

Included in the keys, in addition to native predators, are the larvae of three species of introduced predators which have become established in North Carolina. These are *Laricobius erichsonii* Rosenhauer (Coleoptera: Derodontidae), *Aphidoletes thompsoni* Möhn (Diptera: Cecidomyiidae), and *Aphidecta obliterata* (L.) (Coleoptera: Coccinellidae), reported by Amman and Speers[1] and by Amman.[2]

A guide to the identification of principal adult Coccinellid predators of the balsam woolly aphid in North Carolina was presented by Witter and Amman.[3]

Color provides a rapid and accurate means of identification and is described extensively in the keys. Descriptions and drawings have been included which emphasize some of the more obvious characteristics of the predators and which can be seen easily with a 10X hand lens. Most of these descriptions were prepared in conjunction with life cycle studies conducted in the laboratory.[4]

Initial identifications of predators were made by personnel of the Insect Identification and Parasite Introduction Branch of the Agricultural Research Service, the United States National Museum, and the Smithsonian Institution. Several of the original drawings were prepared by Emmett T. Wilson, Jr., Biological Aid (now with Division of State and Private Forestry, USDA Forest Service, Southern Region, Asheville, N. C.).

[1]Amman, G. D., and Speers, C. F. Release of predators of the balsam woolly aphid in North Carolina. Southeast. Forest Exp. Sta., U. S. Forest Serv. Res. Note SE-32, 4 pp. 1964.

[2]Amman, G. D. *Aphidecta obliterata* (Coleoptera: Coccinellidae), an introduced predator of the balsam woolly aphid, *Chermes piceae* (Homoptera: Chermidae), established in North Carolina. J. Econ. Entomol. 59: 506-508. 1966.

[3]Witter, J. A., and Amman, G. D. Field identification and sex determination of *Aphidecta obliterata*, an introduced predator of *Adelges piceae*. Ann. Entomol. Soc. Amer. 62: 718-721. 1969.

[4]Amman, G. D. A study of the native predators of the balsam woolly aphid, *Chermes piceae* Ratz. (Homoptera: Chermidae), in North Carolina. Ph.D. Diss., Univ. Mich., Ann Arbor, 226 pp. 1966.

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Key to Insect Larvae

1. Larva without legs.....2

   Larva with legs.....8

2. Uniform orange, less than 4 mm. in length ..... (Cecidomyiidae).....3

   Color other than orange, or if orange, forming a broken pattern, longer than 4 mm.....4

3. Caudae curved and pointed (fig. 1A)..... ..... Unidentified cecidomyiid

   Caudae straight and truncated (fig. 1B).... ..... *Aphidoletes thompsoni* Möhn

4. Light green to orange with darker orange pigmentation longitudinally and adjacent to dorsal median, flanked by white to cream chevrons on most segments..... (Syrphidae).....*Syrphus torvus* Osten Sacken

   Basically black or light brown to almost translucent 5

5. Mottled black and brown or uniformly black on dorsum 6

   Grayish white to light brown or translucent on dorsum 7

6. Mottled black and brown with white spots on dorsum of most segments...Unidentified syrphid

   Uniform black above, cream below..... ..... Unidentified syrphid

7. Uniform grayish white to light brown, almost translucent at times..... ..... (Syrphidae).....*Pipiza* sp.

   Translucent, narrow, longitudinal white stripe on each side of dorsal median..... ..... Unidentified syrphid

8. Mouthparts sickle-like, long as head, visible from above .....(Hemerobiidae).....9

   Mouthparts chisel-like, shorter than head, invisible from above.....10

9. Dark narrow longitudinal median line on dorsum of head (fig. 2A)..... .....*Hemerobius humulinus* Linnaeus

   Light "V" bordered by dark pigmentation on dorsum of head (fig. 2B)..... .....*Hemerobius stigmaterus* Fitch

10. Pale yellow to grayish green, densely covered with long fine setae (fig. 3)..... ..... (Derodontidae)..... .....*Laricobius erichsonii* Rosenhauer

    Gray to black with white or orange dorsal markings, sparsely covered with short fine setae .....(Coccinellidae).....11

11. Gray, abdomen with orange-yellow pleura, one orange spot on each lateral edge of the first abdominal tergum, integument very spinose (fig. 4A)..... .....*Aphidecta obliterata* (Linnaeus)

    Black with white dorsal markings and white pleura, integument smooth.....12

12. One large median white spot and one small lateroposterior spot each side of the metanotum (fig. 4B)..... .....*Mulsantina hudsonica* (Casey)

    One large median white spot which widens lateroposteriorly on the metanotum and first abdominal tergum (fig. 4C)..... .....*Mulsantina picta* (Randall)

Key to Mites

1. Gnathosoma extended into a long, conelike process resembling a snout, integument smooth except for few setae (fig. 5A)..... ..... (Bdellidae)

   Gnathosoma short and blunt, integument with long setae or dense red pile.....2

2. Body almost round, with large, conspicuous setae (fig. 5B).... (Anystidae).....*Anystis* sp.

   Body oblong, covered with dense red pile.....3

3. Pedipalp with large thumb, chelicerae hooked, last segment of leg uniform in width (fig. 6A) .....(Trombidiidae) .....*Allothrombium mitchelli* Davis

   Pedipalp with inconspicuous thumb, chelicerae long and straight, last segment of leg enlarged (fig. 6B).....(Erythraeidae).....4

4. Uniform red color.....*Leptus* sp.

   Red with a wide, longitudinal silvery area on each side of dorsal median.....*Balaustium* sp.

Key to Slugs

1. Black.....*Pallifera hemphilli* (Binney)

   Grayish white, mottled with light to dark brown spots ..... *Philomycus carolinianus flexuolaris* Rafinesque

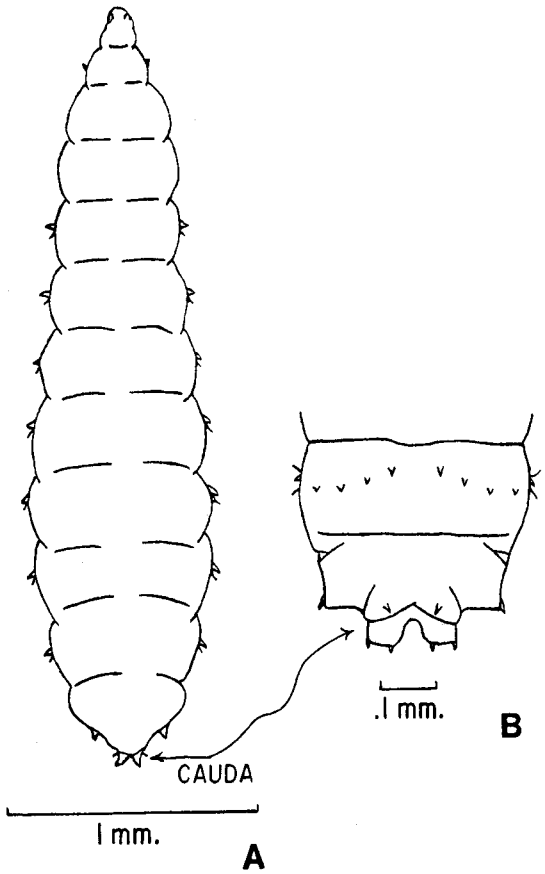


Figure 1. — (A) native cecidomyiid; (B) *Aphidoletes thompsoni.*

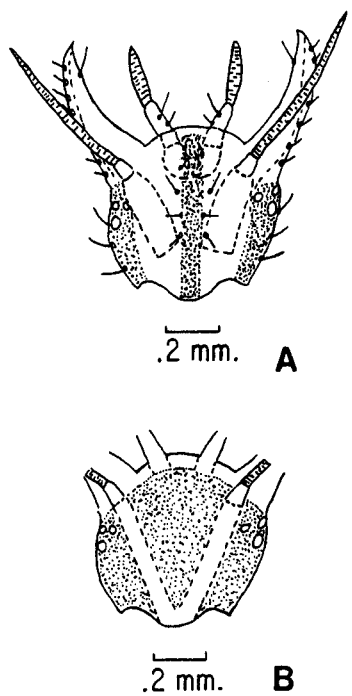


Figure 2. — Heads of third instar hemerobiid larvae: (A) *Hemerobius humulinus;* (B) *H. stigmaterus.*

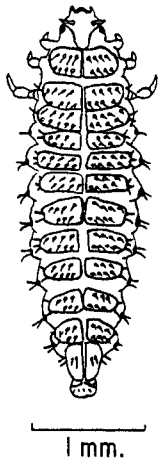
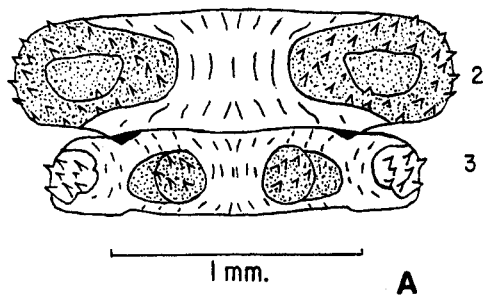
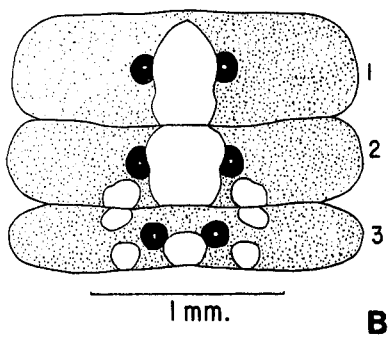


Figure 3. — *Laricobius erichsonii,* third instar larva.





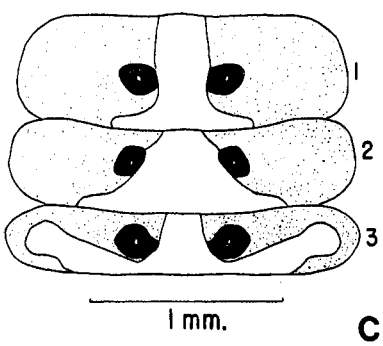
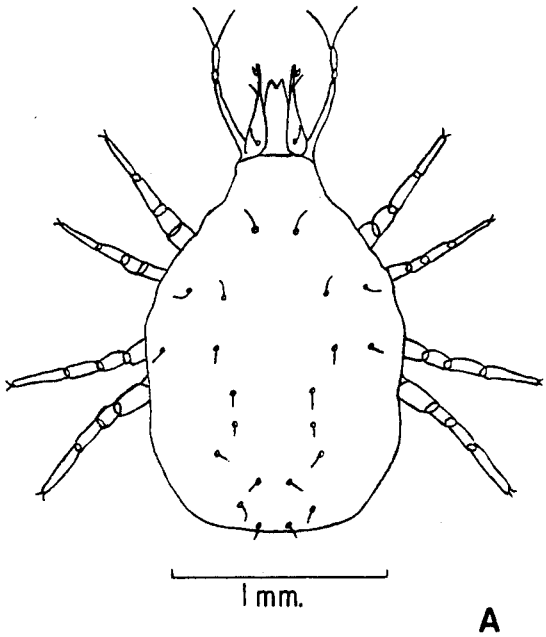


Figure 4. — Drawings showing pigmentation and spinal differences among larvae of three species of Coccinellids: (A) *Aphidecta obliterata;* (B) *Mulsantina hudsonica;* (C) *M. picta.* Numbers at right show (1) mesanotum, (2) metanotum, (3) first abdominal tergum.



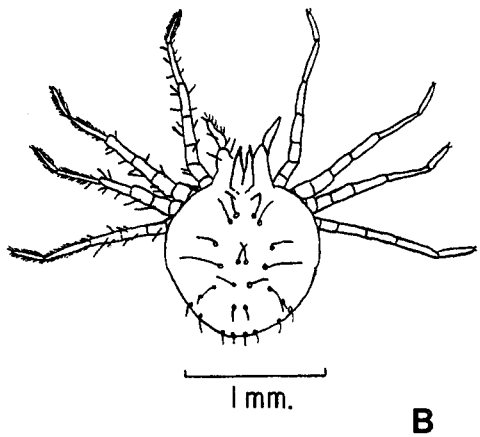


Figure 5. — (A) Bdellidae adult; (B) *Anystis* sp. adult.

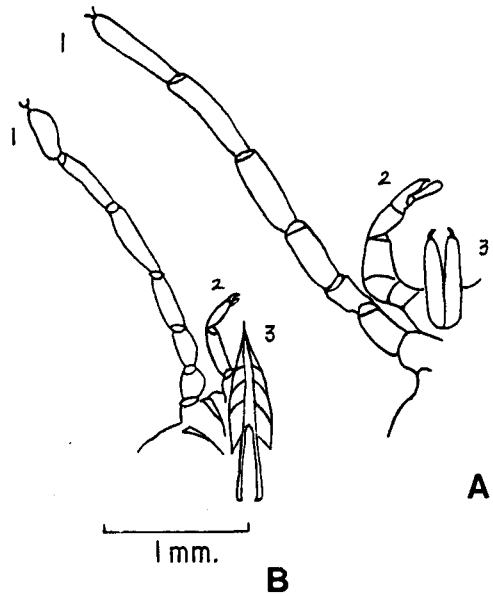


Figure 6. — (A) *Allothrombium mitchelli;* (B) *Leptus* sp. Numbers show (1) leg, (2) pedipalp, and (3) chelicerae.

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